Binge Drinking and Hypertension on Cardiovascular Disease Mortality in Korean Men and Women: A Kangwha Cohort Study

Jae Woong Sull, Sang Wook Yi, Chung Mo Nam, Kwisook Choi and Heechoul Ohrr

Stroke. 2010;41:2157-2162; originally published online August 19, 2010;
doi: 10.1161/STROKEAHA.110.586347
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0039-2499. Online ISSN: 1524-4628

Binge Drinking and Hypertension on Cardiovascular Disease Mortality in Korean Men and Women

A Kangwha Cohort Study

Jae Woong Sull, PhD; Sang Wook Yi, MD, PhD; Chung Mo Nam, PhD; Kwisook Choi, PhD; Heechoul Ohrr, MD, PhD

Background and Purpose—The purpose of this study was to examine combined effects of hypertension and binge drinking on the risk of mortality from cardiovascular disease in Koreans.

Methods—This study followed a cohort of 6100 residents in Kangwha County, aged ≥55 years as of March 1985, for cardiovascular mortality for 20.8 years up to December 31, 2005. We calculated hazard ratios (HRs) for cardiovascular mortality by blood pressure and binge drinking habits using the Cox proportional hazard model. Binge drinkers and heavy binge drinkers were defined as having ≥6 drinks on 1 occasion and ≥12 drinks on 1 occasion.

Results—After adjusting for total alcohol consumption, male heavy binge drinkers with Grade 3 hypertension had a 12-fold increased risk of cardiovascular mortality (HR, 12.7; 95% CI, 3.47 to 46.5), whereas male binge drinkers with Grade 3 hypertension had a 4-fold increased risk of cardiovascular mortality (HR, 4.41; 95% CI, 1.38 to 14.1) when compared with nondrinkers with normal blood pressure. However, in considering separate effects of heavy binge drinking and hypertension on the risk of cardiovascular mortality, HRs were rather low (HR of heavy binge drinkers, 1.88, 1.10 to 3.20; HR of hypertensives, 2.00, 1.70 to 2.35) compared with nondrinkers with normal blood pressure.

Conclusions—Binge drinkers and heavy binge drinkers with Grade 3 hypertension showed a marked increase in cardiovascular mortality risk. Even after adjusting for total alcohol consumption, the former revealed 4.41 and the latter indicated 12.7 of HR for the risk of cardiovascular mortality. **(*Stroke*. 2010;41:2157-2162.)**

Key Words: alcohol ■ cardiovascular diseases ■ epidemiology ■ hypertension ■ mortality

Excessive alcohol consumption causes 75 000 deaths each year in the United States, and it is the third leading preventable cause of death. Binge drinking accounts for more than half of these deaths.[1] Heavy drinking is quite prevalent in Korea. According to The Third Korea National Health and Nutrition Examination Survey in 2005, in which a heavy drinker is defined as one who consumes >6 glasses or 60 g of *soju* for men and >4 glasses or 40 g of *soju* for women on 1 occasion at least once a week, 46.3% of male adults and 9.2% of female adults were heavy drinkers in Korea.[2]

In many studies, binge drinking has been associated with increased risks for cardiovascular mortality, including stroke.[3–5] We also suggested in our recent study that frequent binge drinking is associated with increased risks of all-cause and cerebrovascular disease mortality.[6] Binge drinking may also be associated with increased blood pressure and cause alcohol-related hypertension.[7,8] The positive association of blood pressure level with cardiovascular disease has been well documented.[9] Although hypertension and binge drinking act on cardiovascular mortality risk, combined and specified effects produced by both factors have been rarely studied.

This study examined the joint effects of hypertension and binge drinking on the risk of death from cardiovascular disease in the Korean population through over a 20-year follow-up of the Kangwha Cohort data.

Methods

Study Population

The population for the Kangwha Cohort Study, recruited from the official resident registration records, included residents ≥55 years, who were born before 1930, in 10 administrative districts—*eup*s and *myeon*s in Korean—of Kangwha County as of February 28, 1985 (total, 9378; male, 3938; female, 5440).[6] A total of 6372 persons (2724 males, 3648 females) agreed to participate in the interview and medical examination in the 1985 survey. Details of the Kangwha Cohort Study have been published elsewhere.[6]

Participants who were not followed up after the initial survey (n=78), had a stroke or coronary heart disease before (n=135), or had no information on blood pressure, alcohol intake at entry,

Received April 2, 2010; final revision received May 21, 2010; accepted June 22, 2010.

From the Department of Biomedical Laboratory Science (J.W.S.), College of Health Science, Eulji University, Seongnam, Korea; the Department of Preventive Medicine and Public Health (S.W.Y.), Kwandong University College of Medicine, Gangneung, Korea; the Department of Preventive Medicine and Public Health (C.M.N, H.O.), College of Medicine, Yonsei University, Institute for Health Promotion, Graduate School of Public Health, Yonsei University, Seoul, Korea; and Graduate School of Clinical Health Sciences (K.C.), Ewha Womans University, Seoul, Korea.

Correspondence to Heechoul Ohrr, MD, PhD, the Department of Preventive Medicine and Public Health, College of Medicine, Yonsei University, Seoul, Korea. E-mail ohrr@yuhs.ac

Stroke **is available at http://stroke.ahajournals.org** **DOI: 10.1161/STROKEAHA.110.586347**

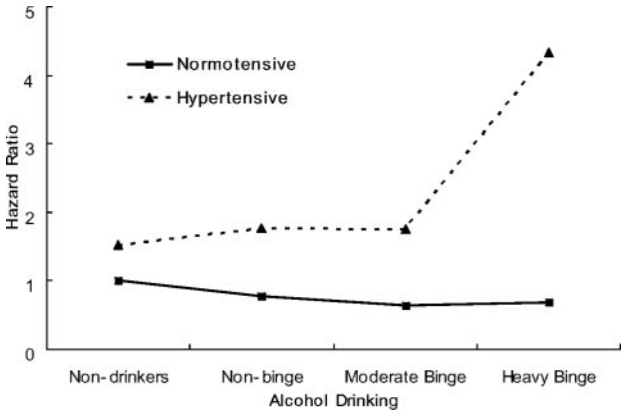

Figure 1. Joint effects of binge drinking habit and BP level (ESH-ESC categories) on the risk of deaths from cardiovascular disease among Korean men aged ≥55 years. Adjusted for age (year of recruitment), the history of chronic disease, the history of diabetes, smoking habits (never, former, 1 to 19 tobacco/day, and ≥20 tobacco/day), total alcohol consumption, body mass index, occupation (agriculture, other), and education status using the Cox proportional hazard model. Analysis was done excluding subjects who had been followed up <5 years. *P* for interaction of hypertension and heavy binge drinking=0.128. Moderate binge drinking was defined as having 6 to 11 drinks on 1 occasion. Heavy binge drinking was defined as having ≥12 drinks on 1 occasion.

education, or smoking amount (n=59) were all excluded, and thus the final study population selected for the analyses was 6100 (male, 2600; female, 3500). They were followed up for mortality over a maximum of 20.8 years until December 31, 2005. The Institutional Review Board of Human Research of Yonsei University approved the study (Approval No. 4-2007-0182).

Baseline Data Collection and Classification of Blood Pressure

Blood pressure (BP) was measured once per person; and the interobserver error was within 2 mm Hg.[10] Hypertension was determined with systolic and diastolic readings of ≥140/90 mm Hg or antihypertensive medication use. Ninety-eight participants were taking antihypertensive drugs. The combined categories of systolic and diastolic BP were also categorized in line with the guidelines of the European Society of Hypertension and the European Society of Cardiology (ESH-ESC).[11] With regard to chronic disease, study participants were asked to answer yes or no to the question, "Do you have any chronic disease or past accident or injury for which you feel uncomfortable in your daily lives including work?" If he or she answered yes, trained staff interviewed the participant for the kind of chronic disease and entered the data. Eight hundred one participants reported neuralgia, 304 dyspepsia, 655 hypertension, 104 arthritis, 287 dyspnea, 75 traffic accidents, 94 lumbago, and 335 other diseases. In this study, however, information on the existence of chronic disease (yes or no) only was used as a covariate for analysis.

Outcome Assessment

Data for those who died from March 15, 1985, to December 31, 1991, were collected either from records of burial and death certificates of eup and myeon offices that are administrative branch offices of local government in Korea or through the family's confirmation of cause of death at calls and visits of trained surveyors twice a year. However, from 1992, we were allowed to use all the national data on cause of death by the Korean National Statistical Office. In fact, each Korean has a unique Resident Registration Number, which is similar to the Social Security Number of the United States. Therefore, from January 1, 1992, to December 31, 2005, we followed up death records by matching data of the cause of death from the National Statistical Office using the Resident Registration Numbers of all the participants including persons who died before 1992. This follow-up, performed through record linkage at the national level, is almost complete, except for emigrants to other countries (N=1) and subjects without information on the Resident Registration Number (N=10).

The main outcome variables for this study were death due to total atherosclerotic cardiovascular disease, total stroke, and hypertensive disease as defined by the International Classification of Disease, 10th Revision (I10 to I25 and I60 to I74 for cardiovascular disease, I60 to I69 for total stroke, and I10 to I15 for hypertensive disease).

Estimation of Alcohol Consumption

Participants were asked to answer yes or no to the question, "Do you drink alcohol?" The frequency of drinking was presented as daily, almost daily, 2 to 3 times a week, 1 to 4 times a month, or 4 to 12 times a year. The question on the type of alcoholic beverage and the amount of alcohol consumption was given as: "How much (in bottle,

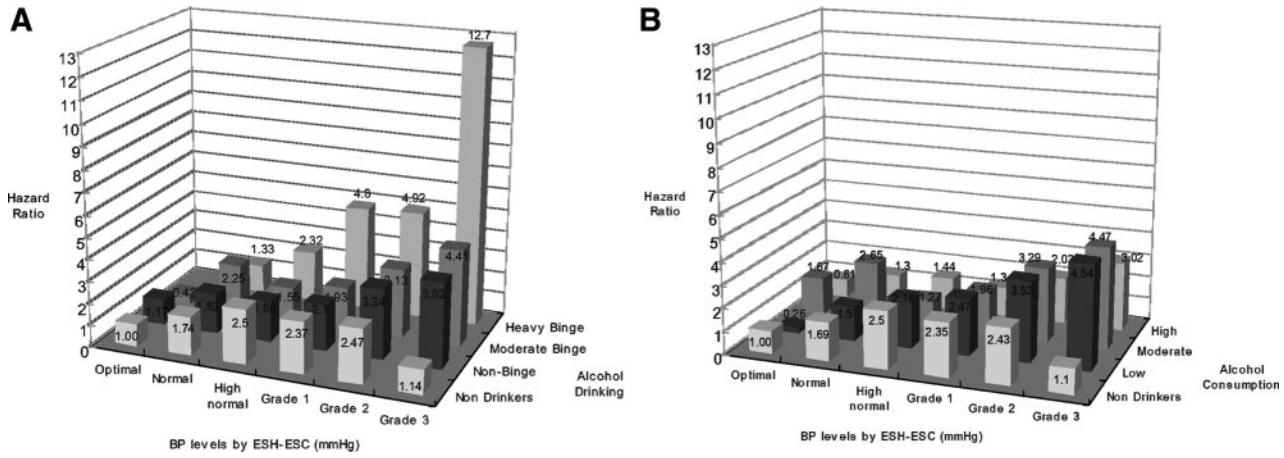

Figure 2. Joint effects of alcohol drinking and BP level (ESH-ESC categories) on the risk of deaths from cardiovascular disease among Korean men aged ≥55 years. A, HR versus both BP categories and binge drinking groups. B, HR versus both BP categories and total alcohol consumption groups. Adjusted for age (year of recruitment), the history of chronic disease, the history of diabetes, smoking habits (never, former, 1 to 19 tobacco/day, and ≥20 tobacco/day), total alcohol consumption, body mass index, antihypertensive medication, occupation (agriculture, other), and education status using the Cox proportional hazard model. Analysis was done excluding subjects who had been followed up <5 years. Moderate binge drinking was defined as having 6 to 11 drinks on 1 occasion. Heavy binge drinking was defined as having ≥12 drinks on 1 occasion.

Table 1. Baseline Characteristics of the Study Population in the Kangwha Cohort Study According to the Experience of Hypertension

Characteristics	Men (N=2600) Normotensives (N=1058) Mean±SD	Men (N=2600) Hypertensives (N=1542) Mean±SD	Men t or χ^2 Value	Women (N=3500) Normotensives (N=1445) Mean±SD	Women (N=3500) Hypertensives (N=2055) Mean±SD	Women t or χ^2 Value
Age, years	64.9±7.0	67.2±7.3	7.95†	64.8±7.9	68.5±8.6	13.2†
BMI, kg/m^2	21.7±14.8	23.2±23.0	2.07*	23.0±18.9	25.5±34.5	2.8†
	No. (%)	No. (%)		No. (%)	No. (%)	
Chronic disease‡			6.65†			2.08
Ever	498 (47.1)	647 (42.0)		692 (47.9)	1035 (50.4)	
Never	560 (52.9)	895 (58.0)		753 (52.1)	1020 (49.6)	
Education			3.96			21.2†
No	402 (38.0)	646 (41.9)		1114 (77.1)	1712 (83.3)	
Elementary	566 (53.5)	774 (50.2)		312 (21.6)	321 (15.6)	
High	90 (8.5)	122 (7.9)		19 (1.3)	22 (1.1)	
Occupation			2.83			0.71
Agriculture	921 (87.1)	1306 (84.7)		1176 (81.4)	1649 (80.2)	
Other	137 (12.9)	236 (15.3)		269 (18.6)	406 (19.8)	
Smoking			4.17			9.20*
Never	209 (19.8)	269 (17.4)		1128 (78.1)	1515 (73.7)	
Former	76 (7.2)	111 (7.2)		28 (1.9)	47 (2.3)	
Current						
1–19 tobacco/day	257 (24.3)	422 (27.4)		214 (14.8)	377 (18.4)	
≥20 tobacco/day	516 (48.8)	740 (48.0)		75 (5.2)	116 (5.6)	
Alcohol drinking			14.9†			2.62
Nondrinking	410 (38.8)	486 (31.5)		1297 (89.8)	1848 (89.9)	
Nonbinge	451 (42.6)	721 (46.8)		138 (9.6)	198 (9.6)	
Moderate binge (6–11 drinks)	164 (15.5)	275 (17.8)		9 (0.6)	6 (0.3)	
Heavy binge (≥12 drinks)	33 (3.1)	60 (3.9)		1 (0.1)	3 (0.2)	

*$P<0.05$.

†$P<0.01$.

‡Study participants were asked to answer yes or no to the question, "Do you have any chronic disease or past accident or injury for which you feel uncomfortable in your daily lives including work?"

BMI indicates body mass index.

glass) do you drink for a type of alcoholic beverage on 1 occasion?" Participants were asked to fill in up to 2 types of alcoholic beverage they usually consume on 1 occasion. A total of 83.9% of male drinkers filled in 1 type only and 16.1% 2 types. Binge drinking was defined as having ≥6 drinks of 1 or 2 types of alcoholic beverage on 1 occasion. One who has ≥12 drinks on 1 occasion was particularly classified as a heavy binge drinker. Alcoholic beverages they consumed most were *soju* and *makkoli*. *Soju* is a distilled alcoholic beverage native to Korea, similar to liquor or *sake* in Japan, and *makkoli* is an unfiltered alcoholic beverage, also native to Korea. In 1985, at the time of survey for the Kangwha Cohort, *soju* contained 25% alcohol by volume and *makkoli* 6% alcohol.[12] To validate those questions on the alcohol consumption questionnaire and to examine the change of alcohol consumption patterns, we implemented the second interview with 3381 survivors in 1994.

Statistical Analysis

With regard to binge drinking habit, they were divided into 4 groups: nondrinkers, nonbinge drinkers, moderate binge drinkers (having 6 to 11 drinks on 1 occasion), and heavy binge drinkers (having ≥12 drinks on 1 occasion). The Cox proportional hazard model was used to calculate the joint effects of hypertension and binge drinking on cardiovascular mortality with nondrinkers with the lowest levels of blood pressure as the reference group. The models according to binge drinking habit were analyzed with results for men only because the sample size of female drinkers was not large enough.

Modification of the effect of binge drinking was assessed by the inclusion of interaction terms of binge drinking category indicators with indicator variables for hypertension (2 categories) and blood pressure level (ESH-ESC categories; Figures 1 and 2A). The joint effects of hypertension and total alcohol consumption on cardiovascular mortality were also analyzed (Figure 2B). The trend test was also conducted with drinking frequency as an ordinal variable. Analyses were performed with SAS Windows Version 9.1.

Results

The baseline characteristics of normotensive and hypertensive subjects are shown in Table 1. The mean (SD) age of men and women in 1985 was 66.3 years (7.2) and 66.9 years (7.1), respectively. On average, normotensive subjects were younger than hypertensive subjects. Binge drinking was associated with the experience of hypertension in men, because hypertensive subjects were more likely to be binge drinkers. Binge drinkers accounted for 31.5% of male alcohol drinkers and 5.2% of female alcohol drinkers.

Table 2. No. of Deaths and Adjusted* HRs of Death From Cardiovascular Diseases by Hypertension Status in the Kangwha Cohort, 1985–2005

Cause of Death	ICD-10	Normotensives† (N=2503)	Hypertensives (N=3597)
Cardiovascular disease	I10–I25, I60–I74		
No. of deaths		209	546
Age standardized rate‡		121.7	246.7
HR (95% CI)[r]		1.00	2.00 (1.70–2.35)
Total stroke	I60–I69		
No. of deaths		146	402
Age-standardized rate‡		85.5	183.7
HR (95% CI)		1.00	2.12 (1.75–2.57)
Hypertensive disease	I10–I15		
No. of deaths		29	89
Age standardized rate‡		16.3	36.5
HR (95% CI)		1.00	2.20 (1.44–3.37)

*Adjusted for age (year of recruitment), sex, history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), alcohol drinking (current drinker, nondrinker), body mass index, occupation (agriculture, other), and education status using the Cox proportional hazard model.

†Reference group: normotensive subjects.

‡Age-standardized rate per 100 000 person-years.

ICD-10 indicates International Classification of Diseases, 10th Revision.

During the 20.8 years of follow-up, 759 subjects died due to cardiovascular disease. Table 2 provides hazard ratios for mortality from cardiovascular diseases by hypertension status. The hazard ratio (95% CI) for cardiovascular mortality was 2.00 (1.70 to 2.35). Hypertension also doubled the risk of dying of stroke. The hazard ratio (95% CI) for stroke mortality was 2.12 (1.75 to 2.57).

Table 3 shows that binge drinking was associated with cardiovascular mortality in men. Compared with nondrinkers, heavy binge drinkers having ≥12 drinks on 1 occasion had significantly increased risks of deaths from cardiovascular disease and hypertensive disease with a hazard ratio (95% CI) of 1.88 (1.10 to 3.20) and 3.71 (1.32 to 10.5), respectively. When we additionally adjusted for total alcohol consumption and excluded subjects who were followed up for <5 years, the association with cardiovascular disease was marginally significant with a hazard ratio (95% CI) of 1.98 (0.96 to 4.10). Although there might be a trend, drinking in these categories was not statistically significantly associated with increased stroke death risk.

The combined effects of binge drinking and hypertension on the risk of deaths from cardiovascular disease are illustrated in Figure 1. Compared with nondrinkers with normal blood pressure, heavy binge drinkers with hypertension had a hazard ratio (95% CI) of 4.33 (1.96 to 9.56) for cardiovascular mortality. However, the interaction of hypertension and heavy binge drinking was not statistically significant (P=0.128). None of the drinking categories is associated with increased cardiovascular disease death risk in normotensives.

Table 4 presents adjusted hazard ratios (HRs) for cardiovascular mortality in relation to BP categories. We observed linear trends in cardiovascular mortality with increasing BP. At the BP levels by ESH-ESC guidelines, P for trends was 0.0009. The HR (95% CI) for Grade 3 hypertension was 3.28 (2.36 to 4.57). The high normal group was also associated with an increased risk of cardiovascular disease mortality (HR, 1.54; 95% CI, 1.12 to 2.11).

Two graphs illustrated in Figure 2 represent the joint effects of BP and binge drinking habit (Figure 2A) and the joint effects of BP and total alcohol consumption (Figure 2B) in relation to ESH-ESC BP categories. Figure 2A shows an increase of cardiovascular mortality risk in the heavy binge drinking group with increasing levels of BP. The HR (95% CI) was 12.7 (3.47 to 46.5) in heavy binge drinkers with Grade 3 hypertension. However, in Figure 2B, there was a small increase in cardiovascular mortality risk among the high alcohol consumption group with increasing levels of BP. The HR (95% CI) was 3.02 (1.02 to 9.00) in the high alcohol consumption group with Grade 3 hypertension. In normotensives, any alcohol drinking group was not associated with increased cardiovascular disease mortality risk (Figure 2).

Discussion

Some studies suggest that moderate alcohol intake may have a beneficial effect on cardiovascular disease, whereas other studies warn that heavy drinking is likely to increase cardiovascular risk. However, most of these studies with mixed results have not taken into account drinking patterns.[13] In the present study, when study subjects were categorized by binge drinking habit, the heavy binge drinking group had a rapidly increased positive relationship with cardiovascular mortality, distinct from other groups. However, any pattern of drinking, even heavy binge drinking, did not significantly increase the risk of dying of stroke (HR, 1.65; 95% CI, 0.85 to 3.21).

In this study, binge drinking was defined as having ≥6 alcoholic drinks on 1 occasion; classified by this definition, 20.4% of male subjects were binge drinkers. When recategorized by weekly pure alcohol consumption, male binge drinkers having ≥6 drinks on 1 occasion were 354 of 558 (63.4%) in the heavy alcohol consumption group; 141 of 536 (26.4%) in the moderate alcohol consumption group; and 54 of 644 (8.4%) in the light alcohol consumption group.

Analyzing the combined effects of binge drinking habit and BP, the present study showed that the relationship of cardiovascular disease with binge drinking resulted in a greater increase in the hypertensive group than in the normative group. As for normotensive subjects, any pattern of drinking, even heavy binge drinking, did not seem to increase the risk of deaths from cardiovascular disease. A Japanese study published in 1995 also reported that the risk of cerebral hemorrhage was increasing as total alcohol consumption increased in hypertensives, whereas there was no relationship between cerebral hemorrhage and drinking in normotensives.[14]

Probable mechanisms for the association between binge drinking and cardiovascular disease have been presented in several studies. According to a study conducted with 20 healthy males, binge drinking increases ambulatory BP.[8]

Table 3. No. of Deaths and Adjusted HRs of Death From Cardiovascular Diseases According to Binge Drinking Among Korean Men

Cause of Death	Nondrinkers (N=896)	Alcohol Drinkers		
		Nonbinge Drinkers (N=1172)	Binge Drinkers	
			Moderate (6–11 Drinks) (N=439)	Heavy (≥12 Drinks) (N=93)
Cardiovascular disease				
No. of deaths	109	151	61	16
Age-standardized rate*	215.4	225.4	242.9	379.9
HR (95% CI)†	1.00	1.07 (0.84–1.38)	1.13 (0.82–1.55)	1.88 (1.10–3.20)
HR (95% CI)‡	1.00	1.02 (0.78–1.32)	1.01 (0.71–1.45)	1.40 (0.69–2.82)
HR (95% CI)‡§	1.00	1.02 (0.77–1.36)	0.97 (0.65–1.44)	1.98 (0.96–4.10)
Total stroke				
No. of deaths	78	108	49	10
Age-standardized rate*	158.5	159.9	197.1	247.1
HR (95% CI)†	1.00	1.07 (0.80–1.44)	1.26 (0.87–1.82)	1.65 (0.85–3.21)
HR (95% CI)‡	1.00	1.01 (0.74–1.37)	1.10 (0.73–1.67)	1.12 (0.47–2.69)
HR (95% CI)‡§	1.00	0.98 (0.71–1.37)	1.00 (0.64–1.58)	1.49 (0.61–3.64)
Hypertensive disease				
No. of deaths	15	28	7	5
Age-standardized rate*	19.9	41.7	26.2	104.5
HR (95% CI)†	1.00	1.34 (0.71–2.54)	0.91 (0.36–2.28)	3.71 (1.32–10.5)
HR (95% CI)‡	1.00	1.23 (0.63–2.37)	0.80 (0.30–2.13)	2.65 (0.67–10.5)
HR (95% CI)‡§	1.00	1.61 (0.68–3.79)	0.82 (0.23–2.97)	5.79 (1.27–26.5)

*Age-standardized rate per 100 000 person-years.

†Adjusted for age (year of recruitment), history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), body mass index, hypertension status, occupation (agriculture, other), and education status using the Cox proportional hazard model.

‡Additionally adjusted for total alcohol consumption.

§Analysis was done excluding subjects who had been followed up <5 years.

Binge drinking may be associated with arterial stiffening and endothelial dysfunction.[15,16] Heavy drinking also precipitates cardiac arrhythmia, thus enhancing the propagation of thrombi in patients with a history of chronic alcohol consumption and heart disease.[17] Additionally, a sudden marked increase of blood flow might easily dislodge a local thrombus attached to the cerebral vessels.[18,19]

This study has several limitations to be discussed. First, alcohol consumption variables were collected through a questionnaire for the Kangwha Cohort of people aged ≥55 years. Some could raise an issue of validity for this. The research team implemented the second interview/test with 3381 survivors in 1994. Percent agreement between drinking status data collected in 1985 and those in 1994 is 87% and Cohen κ value is 0.697. They show substantial agreement between the 2 data. However, no research into the intake of >2 types of alcohol on 1 occasion could remain a limitation of alcohol assessment. In addition, an analysis based on the consumption of wine and beer was not made, because very few people living in rural Kangwha County in 1985 were found to drink wine or beer frequently. In the survey, just 4 participants answered they drank beer most but none for wine. Second, former drinkers were not taken into account because they had not been separately identified as nondrinkers in the survey of 1985. Third, according to a study on diabetes prevalence conducted in a Korean county in the 1970s, the prevalence of diabetes among women aged ≥30 years was 1.5% and just 5% of patients with diabetes knew they had diabetes at the time of the survey.[20] In Korea, particularly Kangwha County, in 1985, diabetes was not a main concern. In the present study, participants who answered that they had ever been hospitalized with diabetes were 20. When we adjusted for diabetes, the results were not different. Additionally, when subjects who died during first 5 years of follow-up were excluded from the analysis, the result of analysis was not so different. Fourth, because smoking is 1 of the cardiovascular risk factors, the rough classification of smoking may be a confounder. To minimize any possible confounding problem, we further divided current smokers. Nevertheless, it still has a possibility of residual confounding. Fifth, the drinking habit of women is much different from that of men.[21] Because of a practical reason that drinkers accounted for only 10.1% in women and female heavy drinkers were scarce, we could not examine the relationship between alcohol consumption and cardiovascular mortality in women as fully as we did in men. Sixth, some sample sizes were small with a limited number of cases. The analysis of different stage hypertension may have a limited statistical

Table 4. No. of Deaths and Adjusted* HRs of Death From Cardiovascular Diseases by BP Categories in the Kangwha Cohort, 1985–2005

	N=6100	
	No. of Deaths	HR (95% CI)
Systolic BP, mm Hg		
<120	70	1.00
120–129	67	0.99 (0.71–1.39)
130–139	89	1.21 (0.89–1.66)
140–149	83	1.27 (0.92–1.75)
150–159	101	1.66 (1.22–2.26)
160–179	165	2.22 (1.67–2.95)
≥180	180	3.27 (2.46–4.34)
P for trends		0.0054
Diastolic BP, mm Hg		
<60	151	1.00
60–69	142	1.04 (0.82–1.30)
70–79	158	1.06 (0.84–1.32)
80–89	125	1.15 (0.91–1.46)
90–99	103	1.58 (1.23–2.04)
≥100	76	2.07 (1.57–2.74)
P for trends		0.0188
BP levels by ESH-ESC, mm Hg		
<120/80 (optimal)	60	1.00
120–129/80–84 (normal)	144	1.36 (1.01–1.85)
130–139/85–89 (high normal)	110	1.54 (1.12–2.11)
140–159/90–99 (Grade 1 hypertension)	213	1.92 (1.44–2.57)
160–179/100–109 (Grade 2 hypertension)	131	2.73 (2.00–3.72)
≥168/110 (Grade 3 hypertension)	97	3.28 (2.36–4.57)
P for trends		0.0009

*Adjusted for age (year of recruitment), sex, history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), alcohol drinking (current drinker, nondrinker), body mass index, antihypertensive medication, occupation (agriculture, other), and education status using the Cox proportional hazard model.

power with insufficient cases. In addition, we could not adjust for different medications for hypertension. Seventh, the physical activities of participants were not questioned at the time of the survey. Because there were a lot of people engaging in agriculture, we adjusted for occupation as a proxy indicator of physical activities instead.

In conclusion, compared with that of nondrinkers, mortality risks from total cardiovascular disease were high in heavy binge drinkers having ≥12 drinks on 1 occasion. Such a relationship markedly increased when heavy binge drinkers were hypertensive. However, because the study population included people aged ≥55 years living in an agricultural community with a small population of female drinkers, further studies need to be undertaken to truly understand the joint effects of hypertension and binge drinking in the entire population.

Acknowledgments

We thank Moon Bong Choi for his helpful comments and editorial assistance.

Sources of Funding

This work was supported by the Korea Science and Engineering Foundation grant (KOSEF: R-01-1993-000-00073-0) funded by the Ministry of Science and Technology of Korea. This study was also partly funded by the Seoul City R&BD program (10526).

Disclosures

None.

References

1. Centers for Disease Control and Prevention (CDC). Alcohol-attributable deaths and years of potential life lost—United States, 2001. *MMWR Morb Mortal Wkly Rep*. 2004;53:866–870.
2. Ministry of Health and Welfare. *The Third Korea National Health and Nutrition Examination Survey (KNHANES III), 2005—Summary*. Seoul: Korea Centers for Disease Control and Prevention; 2005.
3. Sundell L, Salomaa V, Vartiainen E, Poikolainen K, Laatikainen T. Increased stroke risk is related to a binge-drinking habit. *Stroke*. 2008; 39:3179–3184.
4. Malyutina S, Bobak M, Kurilovitch S, Gafarov V, Simonova G, Nikitin Y, Marmot M. Relation between heavy and binge drinking and all-cause and cardiovascular mortality in Novosibirsk, Russia: a prospective cohort study. *Lancet*. 2002;360:1448–1454.
5. Mukamal KJ, Maclure M, Muller JE, Mittleman MA. Binge drinking and mortality after acute myocardial infarction. *Circulation*. 2005;112: 3839–3845.
6. Sull JW, Yi SW, Nam CM, Ohrr H. Binge drinking and mortality from all causes and cerebrovascular diseases in Korean men and women: a Kangwha Cohort Study. *Stroke*. 2009;40:2953–2958.
7. Puddey IB, Beilin LJ. Alcohol is bad for blood pressure. *Clin Exp Pharmacol Physiol*. 2006;33:847–852.
8. Seppä K, Sillanaukee P. Binge drinking and ambulatory blood pressure. *Hypertension*. 1999;33:79–82.
9. Franklin SS, Lopez VA, Wong ND, Mitchell GF, Larson MG, Vasan RS, Levy D. Single versus combined blood pressure components and risk for cardiovascular disease: the Framingham Heart Study. *Circulation*. 2009;119: 243–250.
10. Kim IS, Suh I, Ohrr H, Lee YH. Study of risk factors for hypertension in a rural adult population. *Korean J Epidemiol*. 1981;3:37–43.
11. Thomas F, Blacher J, Benetos A, Safar ME, Pannier B. Cardiovascular risk as defined in the 2003 European blood pressure classification: the assessment of an additional predictive value of pulse pressure on mortality. *J Hypertens*. 2008;26:1072–1077.
12. Korea Alcohol & Liquor Industry Association. *J Korea Alcohol Liquor Ind*. 1986;6:65–69.
13. Mazzaglia G, Britton AR, Altmann DR, Chenet L. Exploring the relationship between alcohol consumption and non-fatal or fatal stroke: a systematic review. *Addiction*. 2001;96:1743–1756.
14. Kiyohara Y, Kato I, Iwamoto H, Nakayama K, Fujishima M. The impact of alcohol and hypertension on stroke incidence in a general Japanese population. The Hisayama Study. *Stroke*. 1995;26:368–372.
15. Kurihara T, Tomiyama H, Hashimoto H, Yamamoto Y, Yano E, Yamashina A. Excessive alcohol intake increases the risk of arterial stiffening in men with normal blood pressure. *Hypertens Res*. 2004;27:669–673.
16. Hijmering ML, de Lange DW, Lorsheyd A, Kraaijenhagen RJ, van de Wiel A. Binge drinking causes endothelial dysfunction, which is not prevented by wine polyphenols: a small trial in healthy volunteers. *Neth J Med*. 2007;65:29–35.
17. Lip GY, Beevers DG, Singh SP, Watson RD. ABC of atrial fibrillation. Aetiology, pathophysiology, and clinical features. *BMJ*. 1995;311: 1425–1428.
18. Hillbom M, Numminen H, Juvela S. Recent heavy drinking of alcohol and embolic stroke. *Stroke*. 1999;30:2307–2312.
19. Gabbay FH, Krantz DS, Kop WJ, Hedges SM, Klein J, Gottdiener JS, Rozanski A. Triggers of myocardial ischemia during daily life in patients with coronary artery disease: physical and mental activities, anger and smoking. *J Am Coll Cardiol*. 1996;27:585–592.
20. Kim KS, Choi CH, Lee DY, Kim EJ. Epidemiological study on diabetes mellitus among rural Korean. *The Journal of the Korean Diabetes*. 1972; 1:17–24.
21. Plant ML. *Women and Alcohol: Contemporary and Historical Perspectives*. London: Free Association Books; 1997.

Full Article

과음과 고혈압이 한국인의 심혈관질환 사망률에 미치는 영향

강화 코호트 연구

Binge Drinking and Hypertension on Cardiovascular Disease Mortality in Korean Men and Women

A Kangwha Cohort Study

Jae Woong Sull, PhD; Sang Wook Yi, MD, PhD; Chung Mo Nam, PhD;
Kwisook Choi, PhD; Heechoul Ohrr, MD, PhD

(*Stroke*. 2010;41:2157-2162.)

Key Words: alcohol ■ cardiovascular diseases ■ epidemiology ■ hypertension ■ mortality

배경과 목적: 본 연구의 목적은 한국인의 심혈관질환(cardiovascular disease) 사망률에 대한 고혈압과 과음의 복합적인 영향을 평가하는 것이다.

방법: 1985년 3월 당시 55세 이상이었던 강화도 거주민 6,100명의 코호트를 2005년 12월 31일까지 20.8년간 추적 조사하여 심혈관질환 사망률을 구하였다. 콕스 비례 위험 모형을 이용하여 혈압과 과음 습관에 의한 심혈관 사망률의 위험도(hazard ratio, HR)를 계산하였다. 과음(binge drinking)과 폭음(heavy binge drinking)은 각각 한 번에 6잔 이상, 12잔 이상 마시는 것으로 정의하였다.

결과: 총 알코올 섭취량을 보정한 후 정상 혈압의 술을 마시지 않는 사람과 비교하였을 때, Grade 3의 고혈압이 있고 폭음을 하는 남성에서 심혈관 사망률이 12배 증가하였으며(HR, 12.7; 95% CI, 3.47~46.5), Grade 3의 고혈압이 있는 과음 남성에서는 4배 증가하였다(HR, 4.41; 95% CI, 1.38~14.1). 그러나 과음, 폭음과 고혈압이 심혈관 사망률에 미치는 효과를 분리하여 보았을 때에는 조금 더 낮은 HR을 보였다(과음, 폭음 시의 HR, 1.88, 1.10~3.20; 고혈압의 HR, 2.00, 1.70~2.35).

결론: Grade 3의 고혈압이 있고 폭음 또는 과음을 하는 경우 심혈관질환 사망 위험이 증가하였다. 총 알코올 섭취량을 보정한 후에도, 과음의 경우 HR 4.41, 폭음의 경우 HR 12.7의 심혈관질환 사망 위험을 보였다.

과도한 알코올 섭취는 미국에서 매년 75,000건의 사망을 발생시키며, 이는 예방 가능한 사망 원인 중에서 세 번째로 많다. 그리고 폭음은 음주로 인한 사망의 반 이상을 차지한다.[1] 과음은 한국에서도 꽤 흔한데, 2005년에 시행된 제3차 대한민국 국민건강영양조사(The Third Korea National Health and Nutrition Examination Survey)에 따르면, 1주에 최소 1회, 남성은 소주 6잔 또는 60 g 초과, 여성의 경우 4잔이나 40 g을 초과하는 양을 마시는 경우를 과음으로 정의하였을 때, 한국 성인 남성의 46.3%, 성인 여성의 9.2%가 과음주자로 분류되었다.[2]

많은 연구에서 폭음은 뇌졸중을 포함한 심혈관질환 사망률의 높은 위험과 연관되어 있었다.[3-5] 본 연구자들은 또한 최근 연구에서, 잦은 폭음이 모든 원인의 사망 및 뇌혈관질환(cerebrovascular disease) 사망률의 높은 위험과 연관이 있음을

From the Department of Biomedical Laboratory Science (J.W.S.), College of Health Science, Eulji University, Seongnam, Korea; the Department of Preventive Medicine and Public Health (S.W.Y.), Kwandong University College of Medicine, Gangneung, Korea; the Department of Preventive Medicine and Public Health (C.M.N., H.O.), College of Medicine, Yonsei University, Institute for Health Promotion, Graduate School of Public Health, Yonsei University, Seoul, Korea; and Graduate School of Clinical Health Sciences (K.C.), Ewha Womans University, Seoul, Korea.

Correspondence to Heechoul Ohrr, MD, PhD, the Department of Preventive Medicine and Public Health, College of Medicine, Yonsei University, Seoul, Korea. E-mail ohrr@yuhs.ac

제시하였다.[6] 폭음은 혈압 상승과 연관되어 있으며, 술과 관련된 고혈압(alcohol-related hypertension)을 유도하는 것으로 보인다.[7,8] 혈압과 심혈관질환이 양의 상관관계를 보인다는 것은 매우 잘 알려져 있다.[9] 고혈압과 폭음이 심혈관질환 사망 위험에 영향을 준다고 하더라도, 두 요인의 통합적이고 특이적인 효과에 대하여서는 연구된 바가 거의 없다.

본 연구에서는 강화 코호트(Kangwha Cohort) 자료의 20년 이상 추적 관찰 자료를 통해 고혈압과 폭음이 한국인의 심혈관질환 사망 위험에 미치는 통합 효과를 평가하였다.

방법

연구 대상

강화 코호트 연구의 대상은 공식 거주자 등록 기록(official resident registration records)에서 모집하였으며, 1985년 2월 28일 당시, 강화군의 10개의 읍과 면에 거주하는 1930년 이전에 태어난 55세 이상의 거주자를 포함하였다(총 9,378명; 남성 3,938명, 여성 5,440명).[6] 6,372명(남성 2,724명, 여성 3,648명)이 1985년 연구의 면담 및 진찰 참여에 동의하였다. 강화 코호트 연구의 자세한 내용은 다른 곳에 발표되었다.[6]

첫 조사 이후 추적 조사를 받지 않은 참가자(n=78), 이전에 뇌졸중이나 관상동맥질환(coronary heart disease)을 앓았거나(n=135), 혈압, 연구 시작 당시의 음주량, 교육 정도, 또는 흡연량에 대한 자료가 없는 사람(n=59)은 모두 제외하였다. 따라서, 분석에 포함된 최종 연구 대상은 6,100명(남성 2,600명, 여성 3,500명)이었다. 사망률 조사를 위해 2005년 12월 31일까지 최대 20.8년 이상 추적 조사하였다. 본 연구는 연세대학교의 임상 연구 심의 위원회의 승인을 받았다(Approval No. 4-2007-0182).

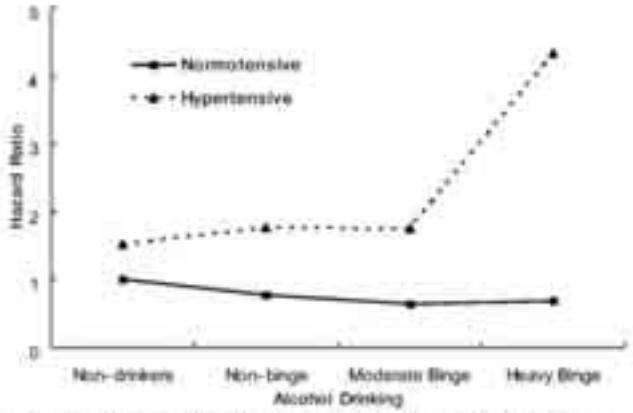

Figure 1. Joint effects of binge drinking habit and BP level (ESH-ESC categories) on the risk of deaths from cardiovascular disease among Korean men aged ≥55 years. Adjusted for age (year of recruitment), the history of chronic disease, the history of diabetes, smoking habits (never, former, 1 to 19 tobacco/day, and ≥20 tobacco/day), total alcohol consumption, body mass index, occupation (agriculture, other), and education status using the Cox proportional hazard model. Analysis was done excluding subjects who had been followed up <5 years. *P* for interaction of hypertension and heavy binge drinking=0.128. Moderate binge drinking was defined as having 6 to 11 drinks on 1 occasion. Heavy binge drinking was defined as having ≥12 drinks on 1 occasion.

기본 자료 수집과 혈압의 분류

혈압은 각 개인별로 1회 측정하였고, 연구자 간의 오류는 2 mm Hg 이내였다.[10] 수축기와 이완기 혈압이 140/90 mm Hg 이상이거나 항고혈압제제를 복용 중인 경우를 고혈압이라고 정의하였다. 참여자 98명이 항고혈압제제를 복용하는 중이었다. 수축기와 이완기 혈압을 통합한 범주 또한 European Society of Hypertension and the European Society of Cardiology (ESH-ESC)의 가이드라인에 따라 분류하였다.[11] 만성 질환에 대하여 연구 참여자는 예, 또는 아니오로 대답할 수 있는 질문을 받았다. "당신은 일을 포함한 일상 생활에 지장을 느낄 만한

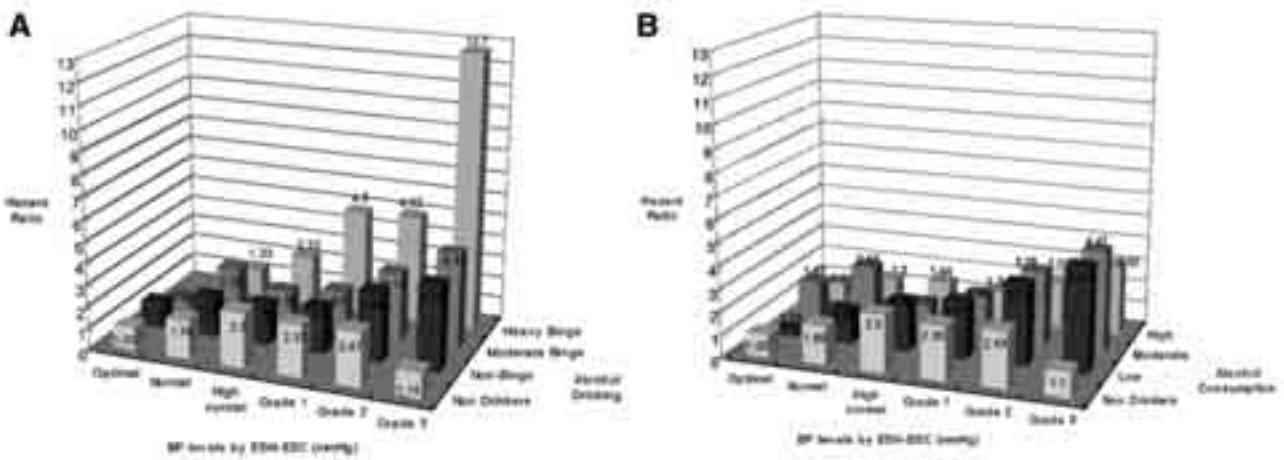

Figure 2. Joint effects of alcohol drinking and BP level (ESH-ESC categories) on the risk of deaths from cardiovascular disease among Korean men aged ≥55 years. A, HR versus both BP categories and binge drinking groups. B, HR versus both BP categories and total alcohol consumption groups. Adjusted for age (year of recruitment), the history of chronic disease, the history of diabetes, smoking habits (never, former, 1 to 19 tobacco/day, and ≥20 tobacco/day), total alcohol consumption, body mass index, antihypertensive medication, occupation (agriculture, other), and education status using the Cox proportional hazard model. Analysis was done excluding subjects who had been followed up <5 years. Moderate binge drinking was defined as having 6 to 11 drinks on 1 occasion. Heavy binge drinking was defined as having ≥12 drinks on 1 occasion.

Table 1. Baseline Characteristics of the Study Population in the Kangwha Cohort Study According to the Experience of Hypertension

Characteristics	Men (N=2600)			Women (N=3500)		
	Normotensives (N=1058) Mean±SD	Hypertensives (N=1542) Mean±SD	t or χ^2 Value	Normotensives (N=1445) Mean±SD	Hypertensives (N=2055) Mean±SD	t or χ^2 Value
Age, years	64.9±7.0	67.2±7.3	7.95†	64.8±7.9	68.5±8.6	13.2†
BMI, kg/m^2	21.7±14.8	23.2±23.0	2.07*	23.0±18.9	25.5±34.5	2.8†
	No. (%)	No. (%)		No. (%)	No. (%)	
Chronic disease‡			8.65†			2.08
Ever	498 (47.1)	647 (42.0)		692 (47.9)	1035 (50.4)	
Never	560 (52.9)	895 (58.0)		753 (52.1)	1020 (49.6)	
Education			3.96			21.2†
No	402 (38.0)	646 (41.9)		1114 (77.1)	1712 (83.3)	
Elementary	566 (53.5)	774 (50.2)		312 (21.6)	321 (15.6)	
High	90 (8.5)	122 (7.9)		19 (1.3)	22 (1.1)	
Occupation			2.83			0.71
Agriculture	921 (87.1)	1306 (84.7)		1176 (81.4)	1649 (80.2)	
Other	137 (12.9)	236 (15.3)		269 (18.6)	406 (19.8)	
Smoking			4.17			9.20*
Never	209 (19.8)	269 (17.4)		1128 (78.1)	1515 (73.7)	
Former	76 (7.2)	111 (7.2)		28 (1.9)	47 (2.3)	
Current						
1–19 tobacco/day	257 (24.3)	422 (27.4)		214 (14.8)	377 (18.4)	
≥20 tobacco/day	516 (48.8)	740 (48.0)		75 (5.2)	116 (5.6)	
Alcohol drinking			14.9†			2.62
Nondrinking	410 (38.8)	486 (31.5)		1297 (89.8)	1848 (89.9)	
Nonbinge	451 (42.6)	721 (46.8)		138 (9.6)	198 (9.6)	
Moderate binge (6–11 drinks)	164 (15.5)	275 (17.8)		9 (0.6)	6 (0.3)	
Heavy binge (≥12 drinks)	33 (3.1)	60 (3.9)		1 (0.1)	3 (0.2)	

*P<0.05.
†P<0.01.
‡Study participants were asked to answer yes or no to the question, "Do you have any chronic disease or past accident or injury for which you feel uncomfortable in your daily lives including work?"
BMI indicates body mass index.

만성 질환이나 과거의 사고, 혹은 상해를 가지고 있습니까?". 만약 참여자가 그렇다고 답한 경우, 훈련된 직원이 각 참여자와 만성 질환의 종류에 대하여 면담하고 자료를 입력하였다. 참여자 801명이 신경통(neuralgia), 304명이 소화장애(dyspepsia), 655명이 고혈압, 104명이 관절염, 287명이 호흡곤란(dyspnea), 75명이 교통사고, 94명이 허리통증(lumbago), 335명이 그 외의 다른 질병이 있다고 보고하였다. 그러나 본 연구에서는 만성 질환의 유무에 대한 정보는 분석의 공변량으로만 사용하였다.

결과 지표 평가

1985년 3월 15일~1991년 12월 31일, 장례 기록과 한국 지방정부의 지역 사무소인 읍, 면사무소의 사망 증명서, 또는 1년에 2회의 전화나 훈련된 조사자의 직접 방문을 통해 사망 원인에 대한 가족들의 확인을 받아 사망자 자료를 수집하였다. 그러나 1992년부터는 대한민국 통계청(Korean National Statistical Office)의 모든 국가 자료를 사용하도록 허가받았다. 사실 모든 한국인은 각각 주민등록번호를 가지며, 이는 미국의 사회보장번호(Social Security Number)와 비슷하다. 그러므로, 1992년 1월 1일~2005년 12월 31일에는 1992년 이전에 사망한 사람을 포함한 모든 연구 참가자의 주민등록번호로 짝을 맞추어 통계청의 사망 원인 자료의 사망 기록을 추적하였다. 이 추적 과정은 국가적 차원에서 기록 연계를 통해 이루어져, 다른 나라에서 이민 온 경우(N=1)와 주민등록번호 자료가 없는 경우(N=10)를 제외하고는 거의 완벽하다.

주요 결과 변수는 국제질병분류(International Classification of Disease) 10 개정판을 이용하여 심혈관질환 I10~I25, I60~I74, 뇌졸중 I60~I69, 고혈압성 질환 I10~I15으로 규명된, 죽상동맥경화 심혈관질환(atherosclerotic cardiovascular disease), 뇌졸중, 고혈압성 질환에 의한 사망으로 정하였다.

알코올 섭취량 측정

참여자는 "당신은 술을 마십니까?"라는 질문에 대하여 예, 또는 아니오로 답하도록 하였다. 음주 빈도는 매일, 거의 매일, 1주에 2~3회, 한 달에 1~4회, 1년에 4~12회로 표기하였다. 술의 종류와 양에 대한 질문은 다음과 같았다. "술을 마실 때, 어떤 종류의 술을 얼마나(병, 잔) 마십니까?". 참여자는 한 번의 술자리에서 마시는 술의 종류를 두 가지까지 고를 수 있도록 하였다. 총 83.9%의 남성 음주자가 1가지 종류만 골랐고, 16.1%는 2가지 종류의 술을 한 번의 술자리에서 마신다고 답하였다. 과음(binge drinking)은 한 번의 술자리에서 하나 또는 두 가지 종류의 술을 6잔(drinks) 이상 마시는 경우로 정의하였다. 한 번에 12잔 이상 마시는 경우는 특별히 폭음(heavy binge drinking)으로 분류하였다. 참여자들이 마시는 술의 종류는 대부분 소주와 막걸리였다. 소주는 한국 고유의 증류주이며, 리쿠어(liquor)나 일본의 정종(sake)과 비슷하다. 막걸리는 역시 한국 고유의 술로 탁주이다. 강화 코호트 연구가 진행된 시기인 1985년에 소주는 25%, 막걸리는 6%의 알코올을 포함하고 있었다.[12] 알코올 섭취량에 대한 질문의 타당도를 확인하고 알코올 섭취 패턴의 변화를 평가하기 위해, 1994년에 3,381명의 생존자를 대상으로 하여 두 번째 면담을 실시하였다.

통계 분석

과음 습관에 따라 연구 대상을 다음의 네 군으로 나누었다. 비음주, 비과음(nonbinge drinkers), 중등도의 과음(과음, moderate binge drinkers, 한 번에 6~11잔), 고도의 과음(폭음, heavy binge drinkers, 한 번에 12잔 이상). 고혈압과 과음이 심혈관질환 사망에 미치는 통합적인 영향을, 술을 마시지 않고 혈압이 낮은 사람을 참고군으로, 콕스 비례 위험 모형을 이용하여 계산하였다. 여성 음주자의 수가 충분하지 않았기 때문에, 과음 습관에 따른 모형은 남성에서만 분석하였다.

과음의 효과에 대한 분석은 과음 범주 지표와 고혈압(두 범주) 및 각 단계의 혈압(ESH-ESC 범주)의 변수들로 구한 상호작용 변수(interaction term)를 삽입하여 구하였다(Figure 1, 2A). 고혈압과 총 알코올 섭취량의 심혈관질환 사망률에 대한 복합적 영향 또한 분석하였다(Figure 2B). 음주 빈도를 순위변수로 하여 추세 검정(trend test)을 실시하였다. 통계 분석은 SAS Windows Version 9.1을 사용하였다.

결과

정상 혈압군과 고혈압군의 기초적 특징은 Table 1에 표시하였다. 1985년의 남성과 여성의 평균 연령(표준편차)은 66.3세(7.2), 66.9세(7.1)였다. 평균적으로 고혈압이 있는 사람보다 정상 혈압인 경우가 더 젊었다. 과음은 남성에서 고혈압 경험과 연관되어 있었는데, 고혈압인 경우 과음하는 경우가 많았다. 남성 음주자의 31.5%, 여성 음주자의 5.2%가 과음을 하는 것으로 나타났다.

Table 2. No. of Deaths and Adjusted* HRs of Death From Cardiovascular Diseases by Hypertension Status in the Kangwha Cohort, 1985–2005

Cause of Death	ICD-10	Normotensives† (N=2503)	Hypertensives (N=3597)
Cardiovascular disease	I10–I25, I60–I74		
No. of deaths		209	546
Age standardized rate‡		121.7	246.7
HR (95% CI)		1.00	2.00 (1.70–2.35)
Total stroke	I60–I69		
No. of deaths		146	402
Age-standardized rate‡		85.5	183.7
HR (95% CI)		1.00	2.12 (1.75–2.57)
Hypertensive disease	I10–I15		
No. of deaths		29	89
Age standardized rate‡		16.3	38.5
HR (95% CI)		1.00	2.20 (1.44–3.37)

*Adjusted for age (year of recruitment), sex, history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), alcohol drinking (current drinker, nondrinker), body mass index, occupation (agriculture, other), and education status using the Cox proportional hazard model.

†Reference group: normotensive subjects.

‡Age-standardized rate per 100 000 person-years.

ICD-10 indicates International Classification of Diseases, 10th Revision.

20.8년의 추적 기간 동안 759명이 심혈관질환으로 인하여 사망하였다. Table 2에 고혈압 상태에 따른 심혈관질환으로 인한 사망률의 위험도를 표시하였다. 심혈관 사망률의 위험도(95% CI)는 2.00 (1.70~2.35)이었다. 고혈압은 또한 뇌졸중으로 인한 사망 위험을 두 배로 높였다. 뇌졸중 사망률의 위험도(95% CI)는 2.12 (1.75~2.57)였다.

Table 3는 남성에서의 과음과 심혈관 사망률의 연관성을 나타낸 것이다. 술을 마시지 않는 사람과 비교하였을 때, 한 번에 12잔 이상을 마시는 경우(폭음)는 심혈관질환과 고혈압성 질환으로 인한 사망 위험이 의미 있게 증가되었으며, 위험도(95% CI)는 각각 1.88 (1.10~3.20)과 3.71 (1.32~10.5)이었다. 추가로 총 알코올 섭취량을 보정하고 5년 미만 추적한 대상을 제외하여 분석하였을 때, 심혈관질환과의 관계는 위험도(95% CI)가 1.98 (0.96~4.10)로 다소 의미 있는 결과를 보였다. 이 범주의 음주는 비록 경향성이 있기는 하였지만 뇌졸중 사망 위험의 증가와 의미 있게 연관되지는 않았다.

과음과 고혈압이 심혈관질환 사망 위험에 미치는 복합적인 영향에 대하여 Figure 1에 나타내었다. 정상 혈압이고 술을 마시지 않는 사람과 비교하여, 고혈압이 있고 폭음을 하는 사람의 경우 심혈관 사망의 위험도(95% CI)가 4.33 (1.96~9.56)

이었다. 그러나, 고혈압과 폭음의 상호 관계는 통계적으로 유의하지 않았다(P=0.128). 음주 관련 범주 중 어느 경우도 정상 혈압에서 심혈관질환의 사망 위험을 증가시키지 않았다.

Table 4에는 혈압 분류에 따른 심혈관 사망률의 보정된 위험도(HR)를 표시하였다. 혈압이 높아짐에 따라 심혈관 사망률도 선형 추세(linear trend)를 보이는 것을 관찰할 수 있었다. ESH-ESC 가이드라인에 따른 혈압의 각 단계에 대한 경향의 P값은 0.0009였다. Grade 3의 고혈압에 대한 HR (95% CI)은 3.28 (2.36~4.57)이었다. 정상 혈압이지만 높은 범주에 속하는 군에서도 또한 심혈관질환 사망률의 증가를 나타냈다(HR, 1.54; 95% CI, 1.12~2.11).

Figure 2의 그래프는 ESH-ESC 혈압 범주에 따른 혈압과 과음 습관 패턴의 복합적인 영향(Figure 2A), 혈압과 총 알코올 섭취량의 복합적 영향(Figure 2B)을 의미한다. Figure 2A에서 혈압이 올라감에 따라 폭음하는 군의 심혈관 사망 위험도 증가한다는 것을 확인할 수 있다. Grade 3 고혈압을 가진 폭음주자의 HR (95% CI)은 12.7 (3.47~46.5)이었다. 그러나, Figure 2B에서 혈압이 증가함에 따라 알코올 섭취량이 많은 군에서의 심혈관 사망 위험은 약간만 증가하였다. Grade 3 고혈압을 가지고 총 알코올 섭취량이 많은 경우의 위험도(95% CI)는 3.02 (1.02~9.00)였다. 정상 혈압에서는 그 어떤 음주군에서도 심혈관질환 사망 위험 증가와 연관되어 있지 않았다(Figure 2).

고찰

일부 연구에서는 적절한 알코올의 섭취가 심혈관질환에 대하여 좋은 영향을 줄 것이라고 제안하였고, 일부에서는 과음이 심혈관질환의 위험을 높일 것이라고 하였다. 그러나, 이들 혼합된 결과를 나타낸 대부분의 연구들은 음주 패턴을 설명하지 않았다.[13] 본 연구에서, 연구 대상자를 과음 습관에 의하여 분류하였을 때, 과음하는 군이 다른 군과 확연히 다르게 심혈관 사망률이 급격히 증가하는 양의 상관관계를 보였다. 그러나 폭음을 포함한 그 어떠한 음주 습관 패턴에서도 뇌졸중으로 인한 사망률에는 유의한 증가를 나타내지 않았다(HR, 1.65; 95% CI, 0.85~3.21).

본 연구에서 과음은 한 번 술을 마실 때 6잔 이상 마시는 경우로 정의하였고, 이 정의에 의하여 20.4%의 남성 음주자가 과음하는 것으로 분류되었다. 1주당 순수 음주량으로 다시 분류할 때,

Table 3. No. of Deaths and Adjusted HRs of Death From Cardiovascular Diseases According to Binge Drinking Among Korean Men

		Alcohol Drinkers		
			Binge Drinkers	
Cause of Death	Nondrinkers (N=896)	Nonbinge Drinkers (N=1172)	Moderate (6–11 Drinks) (N=439)	Heavy (≥12 Drinks) (N=93)
Cardiovascular disease				
No. of deaths	109	151	61	16
Age-standardized rate*	215.4	225.4	242.9	379.9
HR (95% CI)†	1.00	1.07 (0.84–1.36)	1.13 (0.82–1.55)	1.88 (1.10–3.20)
HR (95% CI)‡	1.00	1.02 (0.78–1.32)	1.01 (0.71–1.45)	1.40 (0.69–2.82)
HR (95% CI)‡§	1.00	1.02 (0.77–1.36)	0.97 (0.65–1.44)	1.98 (0.96–4.10)
Total stroke				
No. of deaths	78	108	49	10
Age-standardized rate*	158.5	159.9	197.1	247.1
HR (95% CI)†	1.00	1.07 (0.80–1.44)	1.26 (0.87–1.82)	1.65 (0.85–3.21)
HR (95% CI)‡	1.00	1.01 (0.74–1.37)	1.10 (0.73–1.67)	1.12 (0.47–2.69)
HR (95% CI)‡§	1.00	0.98 (0.71–1.37)	1.00 (0.64–1.58)	1.49 (0.61–3.64)
Hypertensive disease				
No. of deaths	15	28	7	5
Age-standardized rate*	19.9	41.7	26.2	104.5
HR (95% CI)†	1.00	1.34 (0.71–2.54)	0.91 (0.36–2.28)	3.71 (1.32–10.5)
HR (95% CI)‡	1.00	1.23 (0.63–2.37)	0.80 (0.30–2.13)	2.65 (0.67–10.5)
HR (95% CI)‡§	1.00	1.61 (0.68–3.79)	0.82 (0.23–2.97)	5.79 (1.27–26.5)

*Age-standardized rate per 100 000 person-years.

†Adjusted for age (year of recruitment), history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), body mass index, hypertension status, occupation (agriculture, other), and education status using the Cox proportional hazard model.

‡Additionally adjusted for total alcohol consumption.

§Analysis was done excluding subjects who had been followed up <5 years.

Table 4. No. of Deaths and Adjusted* HRs of Death From Cardiovascular Diseases by BP Categories in the Kangwha Cohort, 1985–2005

	N=6100	
	No. of Deaths	HR (95% CI)
Systolic BP, mm Hg		
<120	70	1.00
120–129	67	0.99 (0.71–1.39)
130–139	89	1.21 (0.89–1.66)
140–149	83	1.27 (0.92–1.75)
150–159	101	1.66 (1.22–2.26)
160–179	165	2.22 (1.67–2.95)
≥180	180	3.27 (2.46–4.34)
P for trends		0.0054
Diastolic BP, mm Hg		
<60	151	1.00
60–69	142	1.04 (0.82–1.30)
70–79	158	1.06 (0.84–1.32)
80–89	125	1.15 (0.91–1.46)
90–99	103	1.58 (1.23–2.04)
≥100	76	2.07 (1.57–2.74)
P for trends		0.0188
BP levels by ESH-ESC, mm Hg		
<120/80 (optimal)	60	1.00
120–129/80–84 (normal)	144	1.36 (1.01–1.85)
130–139/85–89 (high normal)	110	1.54 (1.12–2.11)
140–159/90–99 (Grade 1 hypertension)	213	1.92 (1.44–2.57)
160–179/100–109 (Grade 2 hypertension)	131	2.73 (2.00–3.72)
≥168/110 (Grade 3 hypertension)	97	3.28 (2.36–4.57)
P for trends		0.0009

*Adjusted for age (year of recruitment), sex, history of chronic disease, history of diabetes, smoking habits (never, former, 1–19 tobacco/day, and ≥20 tobacco/day), alcohol drinking (current drinker, nondrinker), body mass index, antihypertensive medication, occupation (agriculture, other), and education status using the Cox proportional hazard model.

한 번에 6잔 이상 마시는 남성 과음주자는 총 알코올 섭취량이 많은 군에서 558명 중 354명(63.4%), 중간 정도의 알코올 섭취량을 나타낸 군에서 536명 중 141명(26.4%), 소량의 총 알코올 섭취량군에서 644명 중 54명(8.4%)이었다.

과음 습관과 혈압의 복합적 영향을 분석한 결과, 본 연구는 과음이 정상 혈압군에서보다 고혈압군에서 심혈관질환과의 연관성을 더 크게 증가시킨다는 것을 보여 주었다. 정상 혈압군에서, 폭음을 포함한 그 어떠한 음주 습관 패턴에서도 심혈관질환으로 인한 사망의 증가는 보이지 않았다. 1995년에 발표된 한 일본 연구에서도, 고혈압군에서는 알코올 섭취량이 증가할수록 뇌출혈(cerebral hemorrhage) 위험이 높아지나 정상 혈압군에서는 뇌출혈과 음주의 연관성이 없었다고 하였다.[14]

여러 연구에서 과음과 심혈관질환의 연관성을 설명할 만한 기전을 보고하였다. 20명의 건강한 남성을 대상으로 한 한 연구에 따르면, 과음은 활동 혈압(ambulatory BP)을 증가시킨다.[8] 과음은 아마도 동맥의 경화(stiffness)와 내막의 이상 기능과 연관될 것이다.[15,16] 과음은 또한 심장부정맥(cardiac arrhythmia)을 야기하고, 만성 알코올 섭취와 심장병(heart disease)의 과거력이 있는 환자에서 혈전의 이동을 촉진한다.[17] 또한, 갑작스러운 혈류의 증가는 뇌혈관에 붙어 있는 혈전이 쉽게 떨어져 나가도록 할 것이다.[18,19]

본 연구는 몇 가지 짚고 넘어가야 할 제한점을 가진다. 첫째, 알코올 섭취 변수를 55세 이상의 강화 코호트 참여 인구 설문에 의하여 수집하였는데, 일부에서 이에 대한 타당성 문제를 제기할 수 있다. 연구팀에서 1994년에 3,381명의 생존자를 대상으로 두 번째 면담 및 검사를 시행하였다. 1985년과 1994년의 음주 습관 상태 자료의 일치도는 87%였고, 코헨 카파값(Cohen κ value)은 0.697로, 두 자료가 상당히 일치한다는 것을 보여 준다. 그러나 한 번에 두 가지보다 많은 종류의 술을 마시는 경우에 대한 연구가 없었던 것은 여전히 제한점으로 남을 수 있다. 뿐만 아니라, 와인이나 맥주 섭취에 대한 분석이 이루어지지 않았다. 이는 1985년에 강화군에 사는 사람들 중 와인이나 맥주를 자주 마시는 사람이 거의 없었기 때문이다. 연구 조사에서 단 4명만이 맥주를 마셨고, 와인을 마시는 사람은 한 명도 없었다. 두 번째로, 이전에 음주를 했던 경우는 포함시키지 않았는데, 1985년 조사 당시 이를 비음주자로 분류하였고 따로 나누지 않았기 때문이다. 세 번째는, 1970년대에 한국의 군 단위에서 시행한 당뇨병 유병률 연구에 따르면, 30세 이상 여성의 1.5%에서 당뇨병이 있었고, 조사 당시 당뇨병이 있다는 것을 아는 경우는 5%에 불과했다.[20] 1985년의 한국, 특히 강화군에서 당뇨병은 주된 관심사가 아니었다. 본 연구에서 당뇨병으로 인하여 병원에 입원한 적이 있다고 답한 사람은 20명이었다. 당뇨병 유무를 보정하였을 때에도 결과는 다르지 않았고, 추적 5년 이내에 사망한 경우를 분석에서 제외하였을 때에도 결과는 크게 다르지 않았다. 네 번째, 흡연은 심혈관 위험인자 중 하나인데, 흡연 여부에 대한 대략적인 분류가 하나의 혼동 요인이 될 수 있다. 가능한 혼동 효과를 최소화하기 위해 현재 흡연자를 분류하였지만, 이는 여전히 혼동 요인으로 남을 수 있다. 다섯 번째로, 여성의 음주 습관은 남성과 많이 다르다.[21] 여성의 10.1%만이 음주를 하는 것으로 나타나, 여성의 경우 과음주자는 거의 없었으며, 따라서, 여성에서는 음주량과 심혈관 사망률의 관계를 남성에서처럼 자세히 평가할 수 없었다. 여섯 번째로, 일부 표본 크기가 작고 증례 수의 제한이 있었다. 고혈압의 각기 다른 단계별 분석은 부족한 자료가 있어 통계적 검증력이 제한적이고, 고혈압의 여러 약제를 보정할 수 없었다. 일곱 번째로, 참여자의 신체 활동 정도는 조사 당시 질문하지 않았다. 농업에 종사하는 사람이 많았기 때문에, 신체 활동의 근사 지표로 직업을 보정하였다.

결론적으로, 술을 마시지 않는 사람에 비해 한 번에 12잔 이

상 폭음하는 사람의 경우 심혈관질환으로 인한 사망률이 증가하였다. 이러한 관계는 고혈압이 함께 있을 때 크게 증가하였다. 그러나, 농업 사회의 55세 이상의 사람들을 포함하였고, 적은 수의 여성 음주자가 포함된 연구 대상으로 인하여 전체 인구 집단에서의 고혈압과 과음의 통합 효과를 이해하기 위한 추가적인 연구가 필요하다.

Acknowledgments

We thank Moon Bong Choi for his helpful comments and editorial assistance.

Sources of Funding

This work was supported by the Korea Science and Engineering Foundation grant (KOSEF: R-01-1993-000-00073-0) funded by the Ministry of Science and Technology of Korea. This study was also partly funded by the Seoul City R&BD program (10526).

Disclosures

None.

References

1. Centers for Disease Control and Prevention (CDC). Alcohol-attributable deaths and years of potential life lost—United States, 2001. *MMWR Morb Mortal Wkly Rep.* 2004;53:866–870.
2. Ministry of Health and Welfare. *The Third Korea National Health and Nutrition Examination Survey (KNHANES III), 2005—Summary.* Seoul: Korea Centers for Disease Control and Prevention; 2005.
3. Sundell L, Salomaa V, Vartiainen E, Poikolainen K, Laatikainen T. Increased stroke risk is related to a binge-drinking habit. *Stroke.* 2008; 39:3179–3184.
4. Malyutina S, Bobak M, Kurilovitch S, Gafarov V, Simonova G, Nikitin Y, Marmot M. Relation between heavy and binge drinking and all-cause and cardiovascular mortality in Novosibirsk, Russia: a prospective cohort study. *Lancet.* 2002;360:1448–1454.
5. Mukamal KJ, Maclure M, Muller JE, Mittleman MA. Binge drinking and mortality after acute myocardial infarction. *Circulation.* 2005;112: 3839–3845.
6. Sull JW, Yi SW, Nam CM, Ohrr H. Binge drinking and mortality from all causes and cerebrovascular diseases in Korean men and women: a Kangwha Cohort Study. *Stroke.* 2009;40:2953–2958.
7. Puddey IB, Beilin LJ. Alcohol is bad for blood pressure. *Clin Exp Pharmacol Physiol.* 2006;33:847–852.
8. Seppä K, Sillanaukee P. Binge drinking and ambulatory blood pressure. *Hypertension.* 1999;33:79–82.
9. Franklin SS, Lopez VA, Wong ND, Mitchell GF, Larson MG, Vasan RS, Levy D. Single versus combined blood pressure components and risk for cardiovascular disease: the Framingham Heart Study. *Circulation.* 2009;119: 243–250.
10. Kim IS, Suh I, Ohrr H, Lee YH. Study of risk factors for hypertension in a rural adult population. *Korean J Epidemiol.* 1981;3:37–43.
11. Thomas F, Blacher J, Benetos A, Safar ME, Pannier B. Cardiovascular risk as defined in the 2003 European blood pressure classification: the assessment of an additional predictive value of pulse pressure on mortality. *J Hypertens.* 2008;26:1072–1077.
12. Korea Alcohol & Liquor Industry Association. *J Korea Alcohol Liquor Ind.* 1986;6:65–69.
13. Mazzaglia G, Britton AR, Altmann DR, Chenet L. Exploring the relationship between alcohol consumption and non-fatal or fatal stroke: a systematic review. *Addiction.* 2001;96:1743–1756.
14. Kiyohara Y, Kato I, Iwamoto H, Nakayama K, Fujishima M. The impact of alcohol and hypertension on stroke incidence in a general Japanese population. The Hisayama Study. *Stroke.* 1995;26:368–372.
15. Kurihara T, Tomiyama H, Hashimoto H, Yamamoto Y, Yano E, Yamashina A. Excessive alcohol intake increases the risk of arterial stiffening in men with normal blood pressure. *Hypertens Res.* 2004;27:669–673.
16. Hijmering ML, de Lange DW, Lorsheyd A, Kraaijenhagen RJ, van de Wiel A. Binge drinking causes endothelial dysfunction, which is not prevented by wine polyphenols: a small trial in healthy volunteers. *Neth J Med.* 2007;65:29–35.
17. Lip GY, Beevers DG, Singh SP, Watson RD. ABC of atrial fibrillation. Aetiology, pathophysiology, and clinical features. *BMJ.* 1995;311: 1425–1428.
18. Hillbom M, Numminen H, Juvela S. Recent heavy drinking of alcohol and embolic stroke. *Stroke.* 1999;30:2307–2312.
19. Gabbay FH, Krantz DS, Kop WJ, Hedges SM, Klein J, Gottdiener JS, Rozanski A. Triggers of myocardial ischemia during daily life in patients with coronary artery disease: physical and mental activities, anger and smoking. *J Am Coll Cardiol.* 1996;27:585–592.
20. Kim KS, Choi CH, Lee DY, Kim EJ. Epidemiological study on diabetes mellitus among rural Korean. *The Journal of the Korean Diabetes.* 1972; 1:17–24.
21. Plant ML. *Women and Alcohol: Contemporary and Historical Perspectives.* London: Free Association Books; 1997.